

Sistemas de Comunicaciones

NEW SATELLITE COMMUNICATION AND POSITIONING SYSTEMS

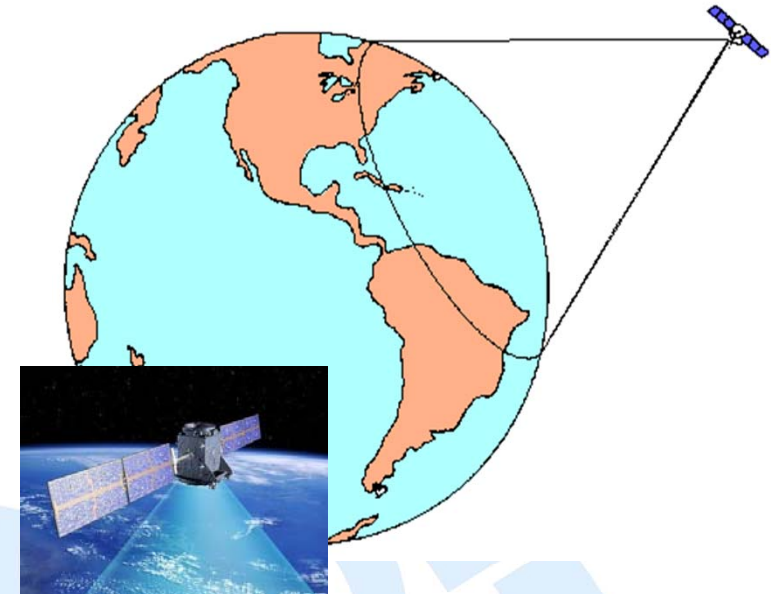
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Overview of the case study

Introduction: satellite systems

ADVANTAGES:

- They are **accessible** from every point of the Earth surface, with a single satellite offering coverage of **large areas** of it.
- They are tremendously **safe** systems (electromagnetically and physically) given the large distance that exists between them and the terrestrial surface.



DISADVANTAGES:

- They constitute **highly complex and expensive** systems that require technologies only available to a small number of countries.
- The enormous distances between the satellites and the surface of the Earth entail the need to establish **sophisticated radio links** (high power transmitters, large aperture antennas and highly sensitive receivers).

CHAPTER 2: Satellite Systems

Depending on their *objective*, the applications of artificial satellites can be classified in three groups:

- **Remote Sensing Satellites.** Include sensors that detect, localize and analyze objects (including the earth surface) or electromagnetic radiation.
- **Communication Satellites.** Used to transmit information.
- **Radio-determination Satellites.** Oriented towards positioning and navigation.

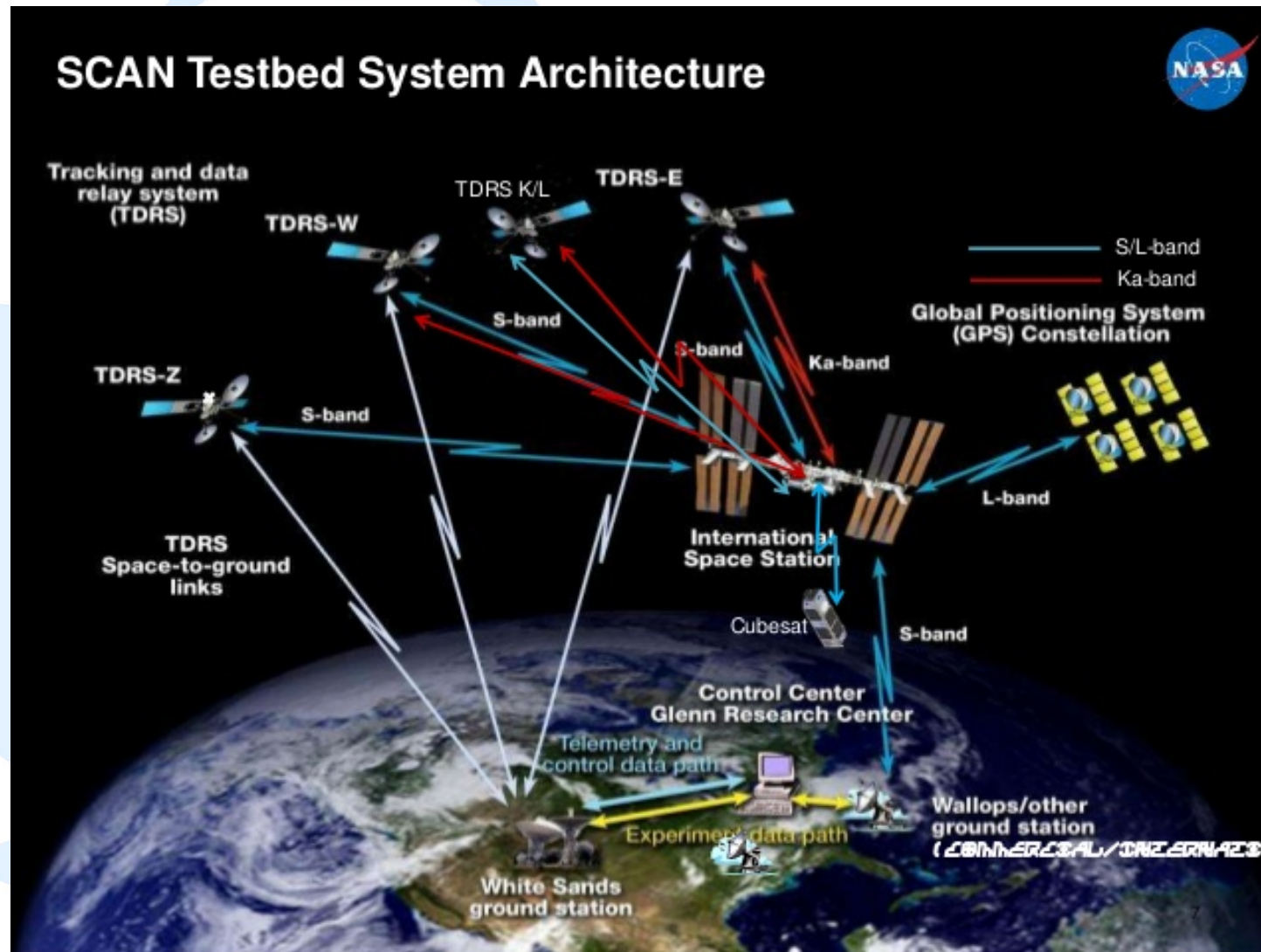
All of them require communication links



Satellite Communication Architectures

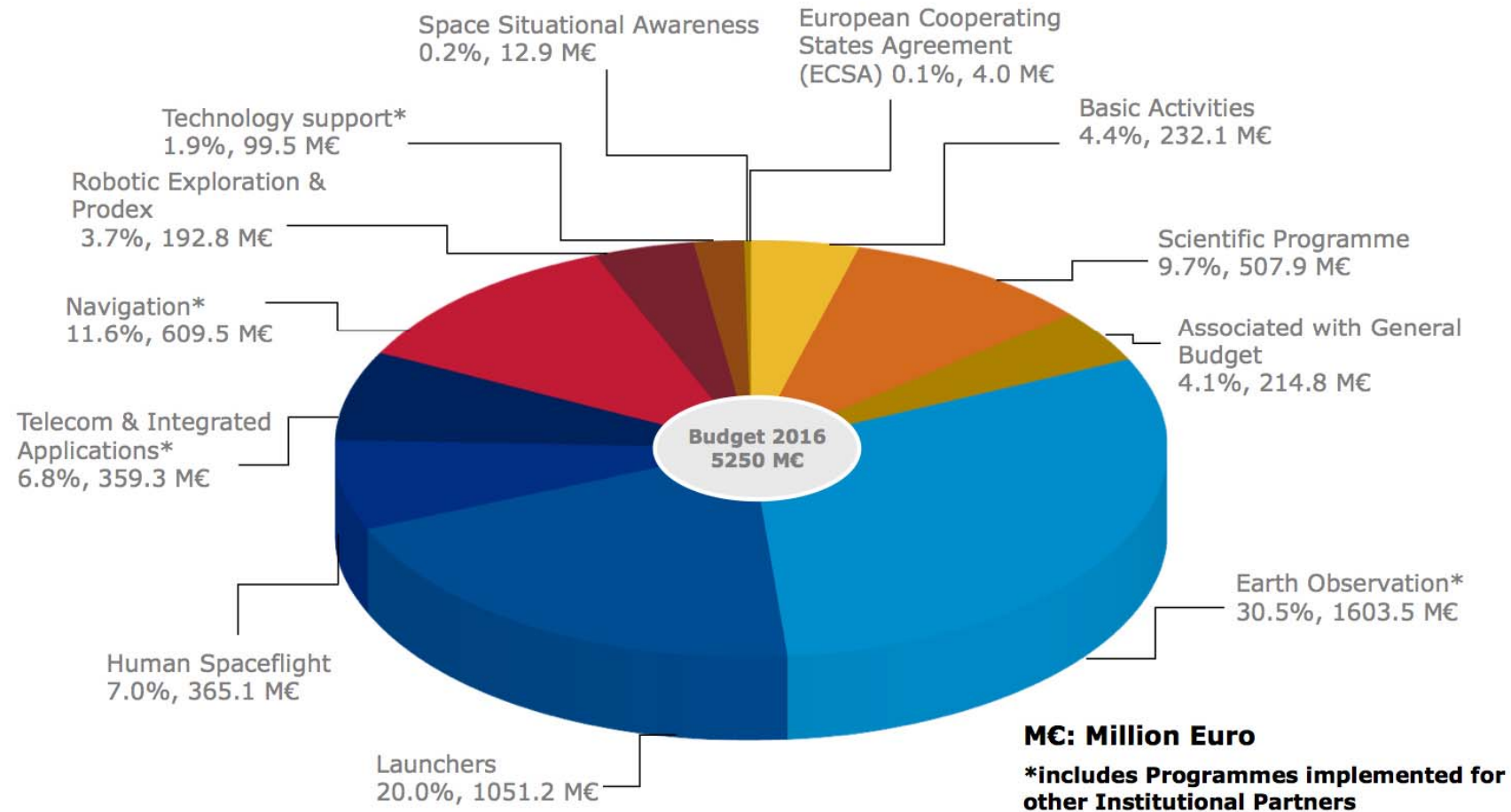
- Satellite Communication Architectures depend on mission and system requirements:
 - Store-and-forward
 - GEO satellite (bent-pipe/regenerative)
 - GEO satellite with intersatellite links
 - LEO satellites with multiple crosslinks
 - Direct transmission link

Satellite Communication Architectures



Space Communications and Navigation (SCaN) Testbed (NASA)

ESA 2016 BUDGET BY DOMAIN



European Space Agency

Goal and methods of case 2

The goal in this part of the course is to learn about the infrastructure of communications based on the use of satellites. In order to do so, and after reviewing basic concepts related to communication systems based on radio transmission, we will describe the main **advantages and disadvantages** of the use of satellites; their **structure**; the **techniques of specification and implementation** of their systems and subsystems; their **design and dimensioning**; and some of their more relevant **applications**. All of it applied to the latest generation of telecommunication and positioning services.

Previous knowledge (ETSIT)

1º-2º GITST

- ✓ Fundamentals of Signal, Communications, Electronics, Electromagnetism

3º-1S -GITST

Sistemas de Transmisión

- ✓ Concept of system
- ✓ Physical environment

3º-2S-GITST

Electrónica de Comunicaciones

- ✓ Components and subsystems
- ✓ Characterization and measurement

1º-1S - MUIT

Sist. de Comunicaciones

- ✓ Global systemic vision
- ✓ Future tendencies

1º-1S – MUIT

Tecnologías de acceso Radio y Redes de Comunicaciones

- ✓ Radio access
- ✓ Link calculation
- ✓ Standards

4º-1S y 2S

Itinerario STEL

- ✓ Modulation and Coding
- ✓ Technologies
- ✓ Components and subsystems
- ✓ Systems (telecommunication, radio-communication and radiodetermination (Satellite Comm. and GPS))

2º-1S - MUIT- SC

Comunicaciones por satélite

2º-1S - MUIT- E y D

Comunicaciones por satélite y Sistemas de Radionavegación

Learning tools:
lectures, lab work and practical work

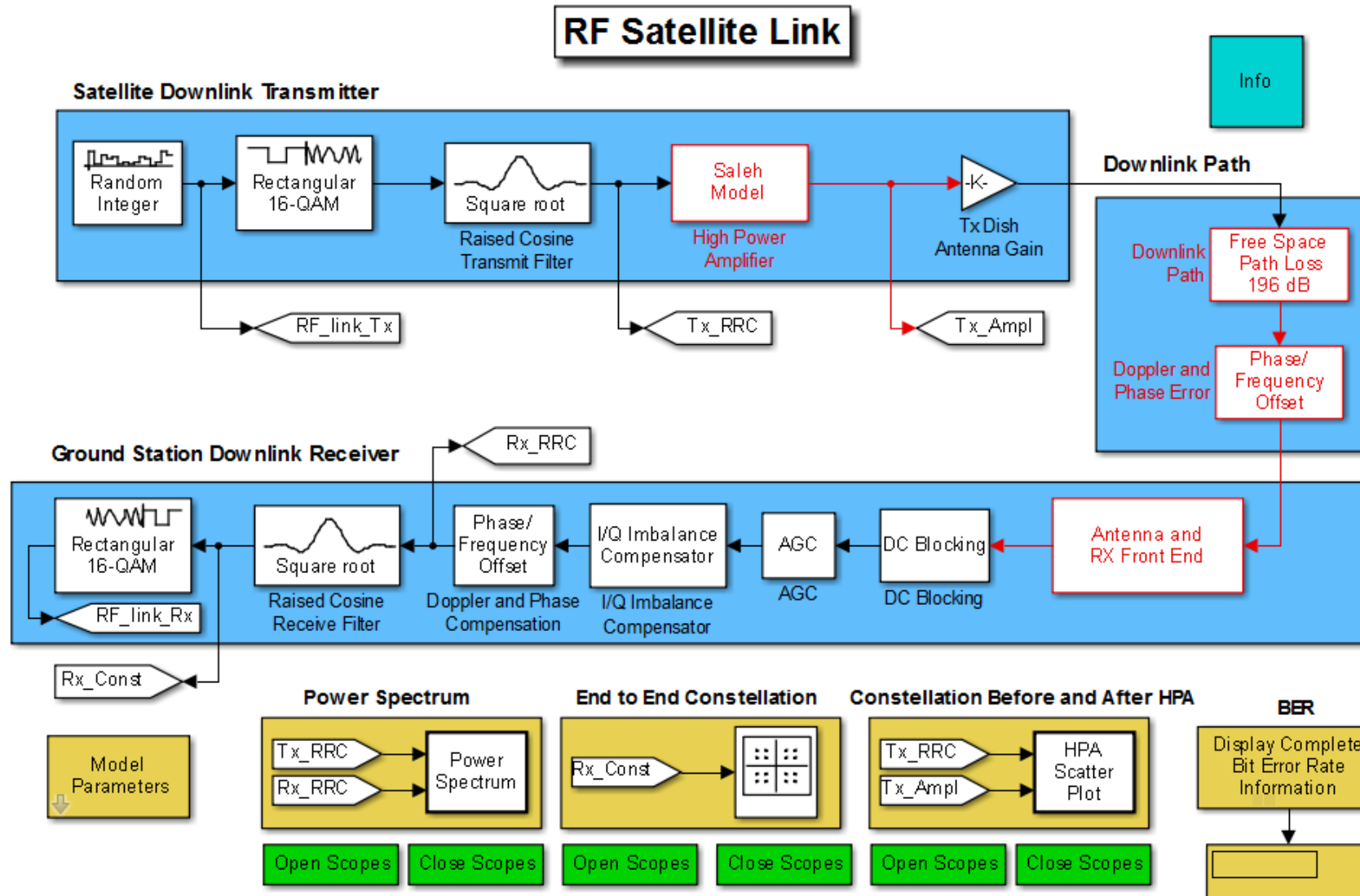
- **Lectures**

- Overview of the case of study
- Radio transmission systems (basic concepts)
- Satellite communication systems
- GNSS systems (Global Navigation Satellite Systems)

- **Lab work**

- During the practical session and for a total of four hours – including the lectures- the student will, through different simulation experiments, come in contact with technologies commonly used in satellite communications.
- Simulation tools: Matlab/Simulink, STK

CHAPTER 2: Satellite Systems



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While running the simulation, double-click on the blocks to open or close scopes

To change parameters as the model is running, apply the changes from the Model Parameters dialog and then apply 'Update Diagram' to the model (ctrl-d).

- Software: System Toolkit (STK)
- Build of complex satellite communication scenarios with satellites, stations and moving targets
- Dynamic simulator
- High performance result visualization and report generation
- Scope: understand orbital parameters and its effect in the satellite communication system
- In A-202.L lab



- **Practical work**

Application of theory to the use of a commercial satellite system containing advanced communication technologies.

Each team of fifteen students must carry out a technical, economic, and commercial study of each of them. Each group will be divided in smaller groups with the following profiles:

- System Engineering
- Design Engineering
- Management and Commercial Engineering

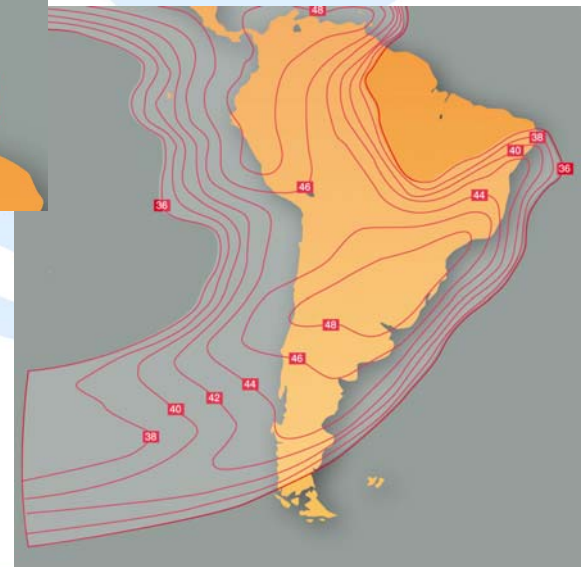
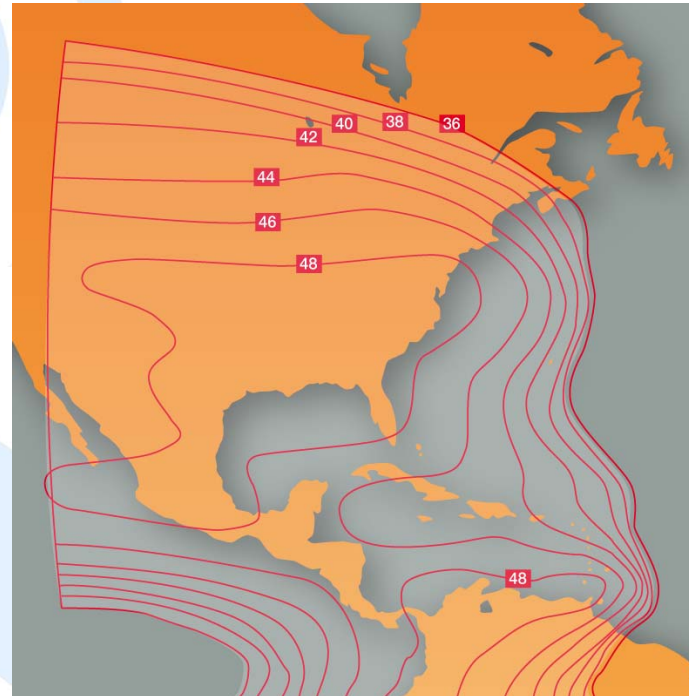
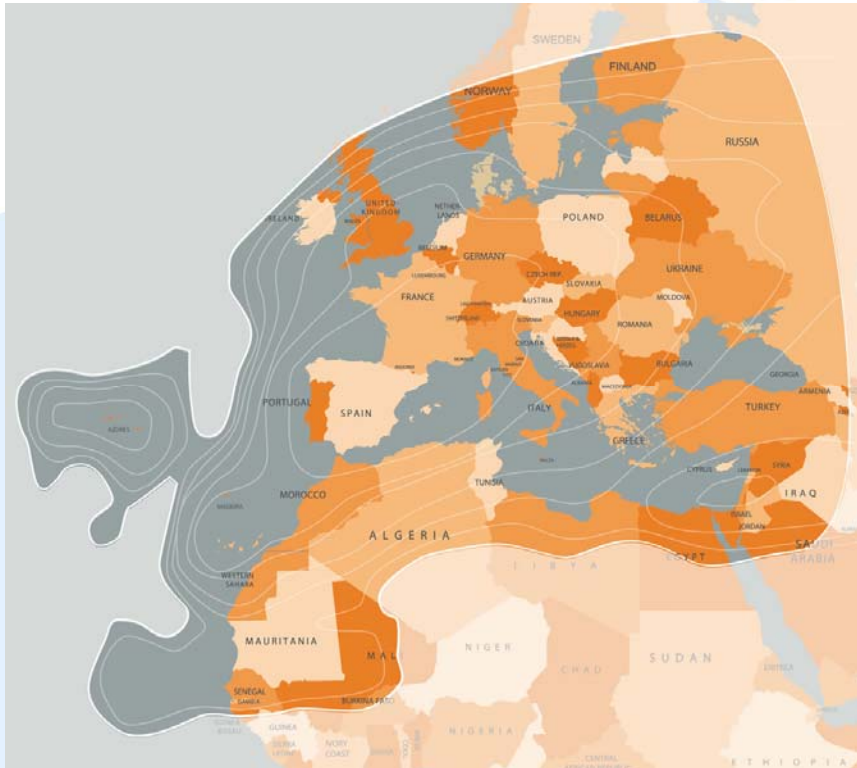
Hispasat 1E – FSS and BSS (Fixed and Broadcasting Satellite Services)

Características técnicas

Descripción	Hispasat 1E
Posición orbital y coberturas	30° Oeste Europa y todo el continente americano
Transpondedores	54 (53 transpondedores en banda Ku, 1 en banda Ka)
Ancho de banda	33 MHz (ku), 36 MHz (Ku), y 500 MHz (Ka)
Nº de antenas	4 (3 desplegadas)
Procesador a bordo	-
Masa seca	2171 kg
Masa de lanzamiento	5,3 Toneladas
Potencia carga útil	11,0 kW
Potencia disponible	> 13,0 kW
Vida útil	15 años
Fabricante	Space Systems Loral
Lanzador	Ariane 5 ECA

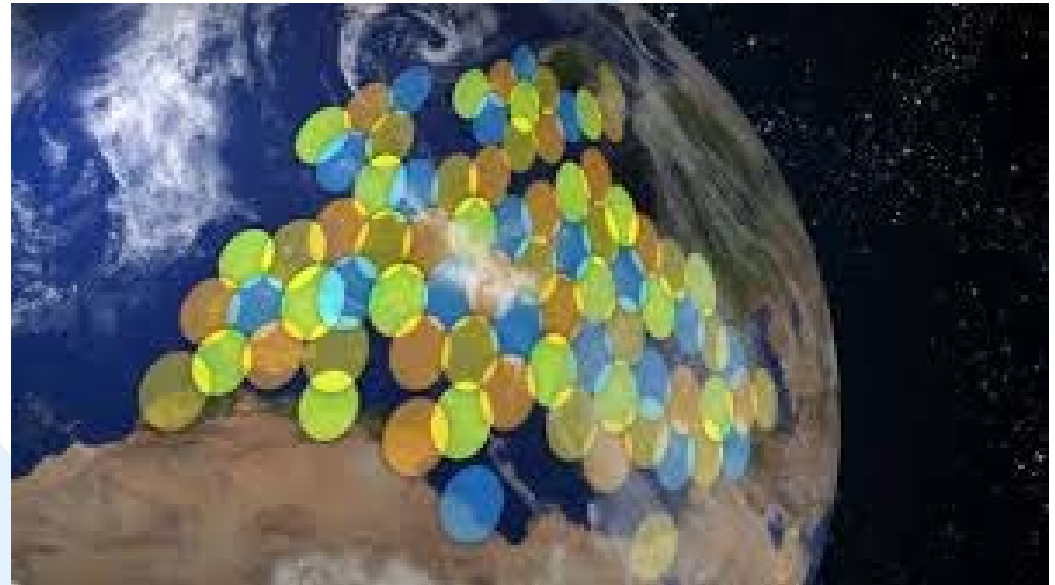
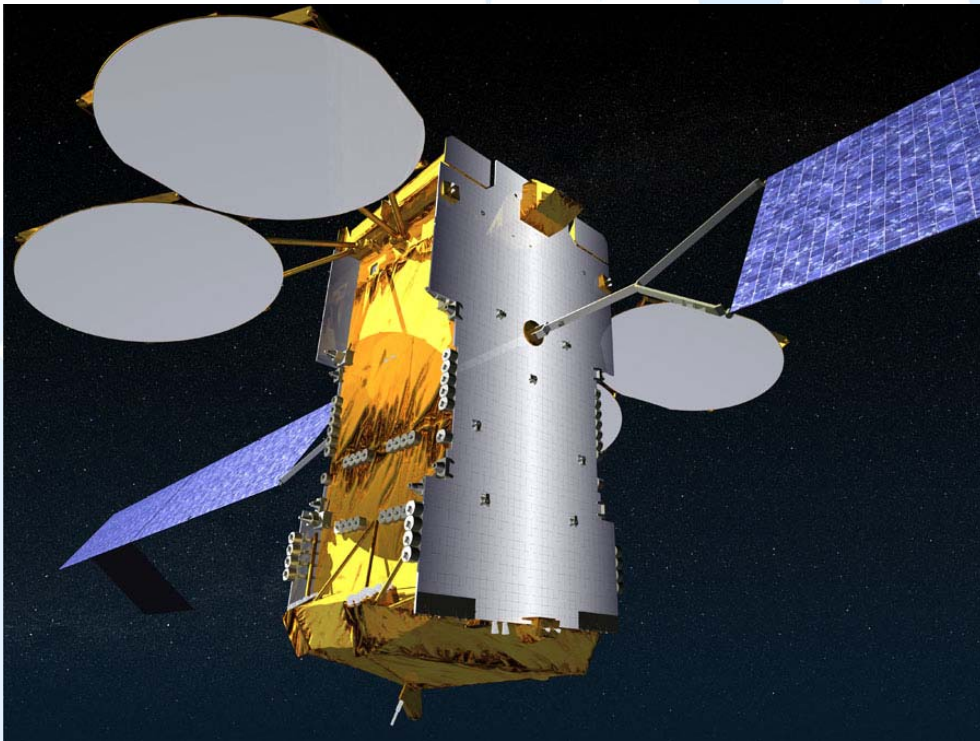
www.hispasat.es

Hispasat 1E – FSS and BSS (Fixed and Broadcasting Satellite Services)



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KaSAT – Broadband access in Europe and Northern Africa



Bibliography

- M. Calvo Ramón, A. García Pino, R. Martínez Rodríguez-Osorio, *Comunicaciones por Satélite*, Servicio de Publicaciones ETSIT-UPM, 2005.
- Gérard Maral, Michel Bousquet, *Satellite Communications Systems*, 4ª ed., John Wiley & Sons, 2002.
- Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt, *Satellite communications*, 2ª ed., John Wiley & Sons, 2003.
- Teresa M. Braun, *Satellite Communications Payload and System*, Wiley-IEEE Press, 2012.
- B.G. Evans, Ed., *Satellite communication systems*, 3ª ed., Institution of Electrical Engineers, 1999.
- Bruce R. Elbert, *The satellite communication applications handbook*, 2ª ed., Artech House, 2004.
- ITU, *Handbook on Satellite Communications*, 3ª ed., 2002.
- Rodolfo Neri, *Comunicaciones por Satélite*, Thomson, 2003.